

REMARKS

Summary of Claim Status

Claims 1-21 are pending in the present application after entry of the present amendment. Claims 1-21 are rejected for the reasons discussed below. Applicants request the favorable reconsideration of the claims and withdrawal of the pending rejections, in view of the present amendment and in light of the following discussion.

Rejections Under 35 U.S.C. § 102

Claims 1, 4-19, and 21 are rejected under 35 U.S.C. § 102(b) as being anticipated by R. Glenn Wood et al., IEEE Transactions on Very Large Scale Integration (VLSI) Systems, Vol. 6, No. 2, June 1998 ("Wood"). Applicants thank the Examiner for an explicit and clear description of how Wood is being read. Applicants have amended Claims 1, 14 and 15 in order to point out more particularly and claim more distinctly the subject matter that Applicants regard as their invention. Applicants respectfully traverse the rejection with regard to all claims.

Independent Claim 1

As pointed out by the Examiner in the present Office Action, Wood teaches "representing the equation as a binary decision diagram (BDD) representing all possible routes for all nets simultaneously." Office Action at p. 2. That is, Wood teaches a system where each and every possible route for every net is considered. As Wood clearly admits, "although it is conceptually straightforward to create the necessary Boolean functions for direct detailed routing for *all* the nets across the *entire* fabric for a complete FPGA, the complexity of the resulting functions is intractable." Wood at p. 224, col. 1, ¶4, lines 2-5 (emphasis in original).

Wood goes on to state that "direct representation of all detailed routes across the entire fabric of even a small FPGA produced satisfiability equations too large to represent and

solve." Wood at p. 224, col. 1, ¶4, lines 6-9. That is, Wood makes it clear that the routability formulation described in Wood is too large to be solved, and therefore while it may be interesting from a conceptual point of view, Wood indicates representing all possible routes for all nets is not a practical solution.

To address this inadequacy, Wood proposes reducing the complexity of the problem by limiting consideration to one region at a time. See, e.g., Wood at p. 224, col. 1, ¶4, line 9 to ¶5, line 8. In particular, Wood only considers slices of vertical channels for routing. See, e.g., Wood at p. 224, Fig. 3. Within each small region, all nets may be considered, but a global router must be used to assign nets to certain regions and then to patch together the final routing solution.

In contrast, the methods of the present application only consider routing solutions for a plurality of nets. That is, not all possible routes are represented in the Boolean function formulations as claimed by Applicants. Instead, a subset of all possible routes comprising all solutions for each net are used in the first Boolean function, for instance as recited in Claim 1. This is very different from the regions approach taught by Wood. Wood requires "boundary constraints on signal I/O's and coarse paths as produced by a global router" to determine routability. Wood at page 230, col. 2, ¶2, lines 5-6. The techniques of Wood further require that only small regions of an FPGA be considered at a time. Id. at lines 4-5. The present invention has different approach to the problem, and in particular, starts with a plurality of routing solutions, does not require any boundary constraints or any global router to provide coarse routes, and can consider an entire device at a time.

In order to highlight this inherent distinction over Wood, Applicants have amended Claim 1 to clarify the relationship between the net and solution of each net/solution pair by reciting "each net/solution pair

comprises a net of the plurality of nets and a routing solution that routes the net." The amendment merely makes explicit what was previously implicit in the claim, and as such, does not narrow the scope of the claim or add any new matter. Therefore, Applicants respectfully request entry of the amendment, and allowance of Claim 1.

Furthermore, Wood merely teaches a formulation that considers two major constraints, namely connectivity and exclusivity. See, e.g., Wood at pp. 223-224, numbered steps 1-5. Wood defines the connectivity constraint as ensuring "that each net actually connects through a set of legal, contiguous routing resources from source to sink." Wood at p. 224, col. 1, ¶1, lines 2-4. In direct contrast, the present invention starts with a set of routing solutions, thereby eliminating the need for a connectivity constraint. That is, by definition, each routing solution is connected, as that term is used by Wood.

In contrast to Wood, the present invention considers the two constraints of liveness and exclusivity in its formulation. See, e.g., Specification at p. 6, lines 17-30. As described in the present application, liveness generally refers to ensuring each net has at least one solution in the final routing solution. See, e.g., Specification at p. 7, lines 4-10. That is, the formulation of Wood relies on a connectivity constraint, whereas the present invention relies on a liveness constraint. Nowhere in Wood is a liveness constraint taught or disclosed. Therefore, Applicants believe Claim 1 is allowable over Wood.

In order to clarify the language of the claims, Applicants have amended Claim 1 to recite that the "first function evaluates to true if there exists a set of values for the variables such that at least one solution is live for each net." This amendment merely makes explicit what was originally implicit in the claim, and thus does not narrow the scope of the claim or add new matter. Therefore, Applicants request entry of the amendment.

For at least the reasons set forth above, Applicants believe Claim 1 is allowable, and Applicants respectfully request withdrawal of the final rejection and allowance of Claim 1.

Independent Claim 14

Claim 14 recites limitations similar to those of Claim 1, and therefore for the reasons set forth above with respect to Claim 1, Applicants believe Claim 14 is also allowable. Applicants have also made minor clarifying amendments to Claim 14 consistent with the amendments made in Claim 1. Such amendments merely clarify the language of the previously presented claim and do not narrow the scope of Claim 14. Therefore, Applicants respectfully request allowance of Claim 14.

Independent Claim 15

Claim 15 recites limitations similar to those of Claim 1, and therefore for the reasons set forth above with respect to Claim 1, Applicants believe Claim 15 is also allowable. Moreover, Claim 15 as originally presented recites limitations related to a liveness function. As noted above, Wood does not teach any liveness function, and therefore Applicants believe Claim 15 is allowable over Wood. Applicants have made a minor clarifying amendment to Claim 15 consistent with an amendment made in Claim 1. The amendment merely clarifies the language of the previously presented claim and does not narrow its the scope. Therefore, Applicants respectfully request allowance of Claim 15.

Dependent Claims 4-13, 16-19, and 21

Claims 4-13 each depend, either directly or indirectly, from Claim 1, and thus include all the limitations of Claim 1. Therefore, for at least the reasons set forth above with respect to Claim 1, Applicants believe Claims 4-13 are also

allowable, and respectfully request allowance of those claims.

Claims 16-19 and 21 each depend, either directly or indirectly, from Claim 15, and thus include all the limitations of Claim 15. Therefore, for at least the reasons set forth above with respect to Claim 15, Applicants believe Claims 16-19 and 21 are also allowable, and respectfully request allowance of those claims.

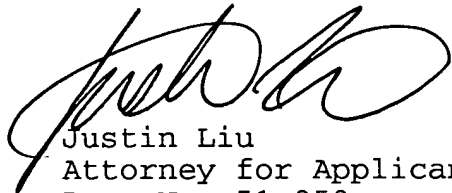
Rejections Under 35 U.S.C. § 103

Claims 2-3 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Abramovici et al., U.S. Patent No. 6,442,742 ("Abramovici"). Claims 2-3 each depend from Claim 1, and thus include all the limitations of Claim 1. Claim 20 depends from Claim 15, and thus includes all the limitations of Claim 15. Therefore, for at least the reasons set forth above, Applicants believe Claims 2-3 and 20 are also allowable, and respectfully request allowance of those claims.

Conclusion

Applicants acknowledge an unusually thorough and helpful analysis of all pending claims by the Examiner. No new matter has been introduced by any of the above amendments. Applicants request that the Examiner reconsider the final rejection and consider the above arguments. These arguments are believed to clearly indicate that the application including Claims 1-21 should be allowed. Therefore, Applicants request allowance of the application. If any action other than allowance is contemplated by the Examiner, the Examiner is invited to telephone Applicants' attorney at 408-879-4641.

Respectfully submitted,

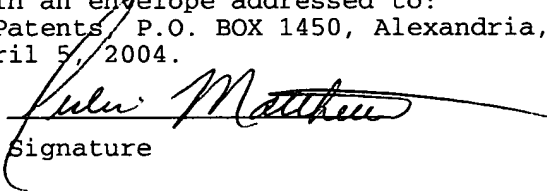


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